

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-063643

(43)Date of publication of application : 05.03.2003

(51)Int.Cl.

B65G 49/06

B65G 49/07

C03B 35/24

H01L 21/68

(21)Application number : 2001-261508

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(22)Date of filing : 30.08.2001

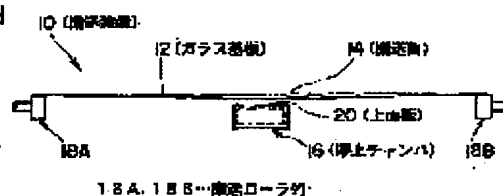
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## (54) THIN PLATE CONVEYING SYSTEM AND APPARATUS

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To raise a thin plate such as a large-scaled glass substrate by using air to convey the thin plate with a lower cost and without causing air turbulence.

**SOLUTION:** A conveying apparatus 10 conveys the glass substrate 12 in parallel with a conveying plane 14. In a widthwise center of the conveying plane 14 a floating chamber 16 elongated along a conveying direction is disposed. On both of widthwise sides of the conveying plane 14, groups of conveying rollers 18A, 18B are disposed. At an upper plate 20 of the floating chamber 16 a number of air jet pores 22 are formed. Static pressure air of low pressure provided through the pores forms fluid film between an upper surface 21 and the glass substrate 12 so that the widthwise center of the glass substrate 12 is raised and, in this situation, conveying power is provided to both the widthwise sides by the groups of conveying rollers 18A, 18B.



## LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

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**CLAIMS**

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[Claim(s)]

[Claim 1] The conveyance approach of the sheet metal characterized by giving the conveyance force by two places of a before [ from the crosswise both sides of said center section / ends ] while surfacing a center section at least with the liquid film of the cross direction which intersects perpendicularly to the conveyance direction of sheet metal which consists of a static pressure gas.

[Claim 2] The conveyance approach of the sheet metal characterized by surfacing the conveyance direction head of said sheet metal center section with a dynamic pressure gas, and delivering to a degree in claim 1 in the location where said liquid film breaks off.

[Claim 3] The conveyance approach of the sheet metal characterized by surfacing the conveyance direction head of said sheet metal center section sent in in the conveyance direction back end location of said static pressure field, and delivering sheet metal to it to said static pressure field when sheet metal is sent into the static pressure field which surfaces the center section of sheet metal with said liquid film in claim 1 or 2.

[Claim 4] The conveyance approach of the sheet metal characterized by stopping conveyance of said sheet metal by reducing the pressure of said static pressure gas in claims 1 and 2 or 3.

[Claim 5] The conveyance approach of the sheet metal characterized by sending a wind so that the sail which can be freely detached and attached at a part of periphery edge of said sheet metal may be attached and the thrust of the conveyance direction of sheet metal may be produced to this sail in claim 1 thru/or either of 4.

[Claim 6] It is a box-like object long in the conveyance direction arranged in the location of the cross direction which intersects perpendicularly with the conveyance direction in a level conveyance side which is equivalent to a center section at least. the abbreviation for sheet metal — Many gas blowout holes are formed in a top-face plate parallel to said plate conveyance side, and a gas is supplied from this gas blowout hole. Between said top-face plates and sheet metal undersides The floatation chamber which forms the liquid film which consists of a static pressure gas which surfaces said center section, The transport device of sheet metal which comes to have a conveyance force grant means to give the conveyance force while being arranged in said conveyance direction and supporting said sheet metal to the part between the crosswise center section in said conveyance side and the crosswise ends of the crosswise both sides of this floatation chamber.

[Claim 7] The transport device of the sheet metal characterized by establishing a dynamic pressure floatation means to spout the dynamic pressure gas which surfaces the conveyance direction head of said sheet metal to facing up or slanting facing up in the edge location of the conveyance direction in said floatation chamber in claim 6.

[Claim 8] It is the transport device of the sheet metal characterized by being constituted so that an application-of-pressure gas may be gushed from the clearance between locations lower than the top face of said top-face plate between the upper bed edge of the conveyance direction end-face plate of the box-like object with which said dynamic pressure floatation means constitutes said floatation chamber in claim 7, and the conveyance direction edge of said top-face plate.

[Claim 9] It is the transport device of the sheet metal which said clearance is formed in claim 8 between the medial surface of said end-face plate, and said conveyance direction edge of said top-face plate, and is characterized by having been arranged lower than the top face of said top-face plate by the upper bed

edge of said end-face plate in the location higher than an underside.

[Claim 10] The transport device of the sheet metal characterized by considering as the inclined plane where the corner of said clearance and opposite hand in the upper bed of said end-face plate was beveled in claim 8 or 9.

[Claim 11] The transport device of the sheet metal characterized by preparing the filter which is arranged in claim 6 thru/or either of 10 at the gas path between the blower which sends a gas into at least one place of said floatation chamber, and this blower and said floatation chamber, and makes regularity the speed of supply of the gas from said blower.

[Claim 12] It is the transport device of the sheet metal which said conveyance force grant means is arranged along the crosswise ends of said conveyance side, and is made into a pivotable conveyance roller train in claim 6 thru/or either of 11, supporting the crosswise ends of said sheet metal, and is characterized by setting the top face of the top-face plate in said floatation chamber as height slightly lower than the level conveyance flat surface which touches the upper bed of said conveyance roller train.

[Claim 13] The transport device of the sheet metal characterized by having estranged on this and crosswise both sides, having arranged this floatation chamber and the sub floatation chamber of the couple of the same configuration to parallel to said floatation chamber in claim 6 thru/or either of 11, having estranged on crosswise both sides of a liquid film formation field with said static pressure gas, and preparing a sub liquid film formation field.

[Claim 14] It is the transport device of the sheet metal characterized by having been arranged, respectively between the sub floatation chambers by which said conveyance force grant means has been arranged in claim 13 at said floatation chamber and its crosswise both sides.

[Claim 15] The transport device of the sheet metal characterized by establishing the guide-idler train which comes to arrange two or more guide idlers which can be freely rotated to the circumference of the revolving shaft of the direction of a vertical along the ends of the cross direction of said conveyance side in claim 6 thru/or either of 14, contacting the crosswise edge of said sheet metal inside the guide-idler train of this couple, and making it make that cross direction position.

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**DETAILED DESCRIPTION**

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**[Detailed Description of the Invention]**

**[0001]**

**[Field of the Invention]** This invention relates to the approach and equipment which convey sheet metal like the large-sized and thin glass substrate used for plate displays, such as a liquid crystal display (LCD) panel and a plasma display panel (PDP).

**[0002]**

**[Description of the Prior Art]** 800mmx1000mm and thickness are 0.7 etc.mm etc., and the large-sized glass substrate for LCD panels has dramatically thin size compared with magnitude.

**[0003]** Therefore, although it will hang down greatly if not only the crosswise ends but a crosswise center section is not supported in case a glass substrate is conveyed horizontally, it is required that a transport device etc. should not contact the part excluding [ such a glass substrate especially ] the periphery edge.

**[0004]** The technique which a substrate is surfaced as a means for this using gases, such as air which is indicated by JP,10-139160,A, JP,11-268830,A, JP,11-268831,A, etc., for example, and is conveyed by non-contact is proposed.

**[0005]**

**[Problem(s) to be Solved by the Invention]** However, by making it the above transport devices spout the compressed air etc. from two or more nozzles, and controlling the blowout direction, a blowout, and a halt intricately Since a substrate is surfaced and he is trying to make it convey in the direction of the object, while a manufacturing cost and operation cost become very high, it sets, for example in a clean room. Since the air of a comparatively high pressure etc. spouts from two or more nozzles, there is a trouble of producing turbulence of the air in a clean room.

**[0006]** Furthermore, in order to solve such a trouble, a porosity ceramics plate is arranged horizontally, air is sent in from the bottom, liquid film is formed between the glass substrate conveyed and porosity ceramics, and there is a thing it was made to surface a glass substrate by this.

**[0007]** However, since it cannot respond to the center section of the glass substrate hanging down in case it passes a thin large-sized glass substrate to other conveyance means from the transport device which consists of a porosity ceramics plate or it is received conversely, while this porosity ceramics plate is dramatically expensive and a manufacturing cost will increase, there is a trouble that fork-like lift equipment must be used.

**[0008]** This invention is made in view of the above-mentioned conventional trouble, and aims at offering the conveyance approach of sheet metal and equipment which were low cost, and enabled it to convey sheet metal, such as a large-sized glass substrate, horizontally, without producing turbulence of the air in a clean room etc.

**[0009]** Moreover, it aims at offering the conveyance approach of sheet metal and equipment it enabled it to deliver and convey, without using a lift at the time of delivery between transport devices, as the center section of sheet metal hanging down does not arise.

**[0010]**

**[Means for Solving the Problem]** This approach invention is two places of a before [ from the crosswise both sides of said center section / ends ], and attains the above-mentioned object by the conveyance approach of the sheet metal characterized by giving the conveyance force while it surfaces a center

section at least with the liquid film of the cross direction which intersects perpendicularly to the conveyance direction of sheet metal which consists of a static pressure gas.

[0011] The conveyance direction head of said sheet metal center section is surfaced with a dynamic pressure gas, and you may make it deliver to a degree in the conveyance approach of said sheet metal in the location where said liquid film breaks off.

[0012] Moreover, when sheet metal is sent into the static pressure field which surfaces the center section of sheet metal with said liquid film, the conveyance direction head of said sheet metal center section sent in is surfaced in the conveyance direction back end location of said static pressure field, and you may make it deliver sheet metal to it to said static pressure field in the conveyance approach of said sheet metal.

[0013] Furthermore, you may make it stop conveyance of said sheet metal by reducing the pressure of said static pressure gas in the conveyance approach of said sheet metal again.

[0014] Moreover, the sail which can be freely detached and attached at a part of periphery edge of said sheet metal is attached, and you may make it send a wind in the conveyance approach of said sheet metal, so that the thrust of the conveyance direction of sheet metal may be produced to this sail.

[0015] It is a box-like object long in the conveyance direction arranged in the location of the cross direction which intersects perpendicularly with the conveyance direction in a level conveyance side which is equivalent to a center section at least. this equipment invention — the abbreviation for sheet metal — Many gas blowout holes are formed in a top-face plate parallel to said conveyance side, and a gas is supplied from this gas blowout hole. Between said top-face plates and sheet metal undersides The floatation chamber which forms the liquid film which consists of a static pressure gas which surfaces said center section, While being arranged in said conveyance direction and supporting said sheet metal in the part between the crosswise center section in said conveyance side and the crosswise ends of the crosswise both sides of this floatation chamber, the transport device of sheet metal which comes to have a conveyance force grant means to give the conveyance force attains the above-mentioned object.

[0016] In the transport device of said sheet metal, a dynamic pressure floatation means to spout the dynamic pressure gas which surfaces the conveyance direction head of said sheet metal may be formed in facing up or slanting facing up in the edge location of the conveyance direction in said floatation chamber.

[0017] Furthermore, in the transport device of said sheet metal, said dynamic pressure floatation means may be made to be constituted so that an application-of-pressure gas may be gushed from the clearance between locations lower than the top face of said top-face plate between the upper bed edge of the conveyance direction end-face plate of the box-like object which constitutes said floatation chamber, and the conveyance direction edge of said top-face plate.

[0018] Furthermore, again, in the transport device of said sheet metal, said clearance is formed between the medial surface of said end-face plate, and said conveyance direction edge of said top-face plate, and may be made to be arranged lower than the top face of said top-face plate by the upper bed edge of said end-face plate in a location higher than an underside.

[0019] Moreover, in the transport device of said sheet metal, it is good also as an inclined plane where the corner of said clearance in the upper bed of said end-face plate and an opposite hand was beveled.

[0020] Furthermore, in the transport device of said sheet metal, it is arranged at the gas path between the blower which sends a gas into at least one place of said floatation chamber, and this blower and said floatation chamber again, and you may make it prepare the filter which makes regularity the speed of supply of the gas from said blower.

[0021] Moreover, in the transport device of said sheet metal, said conveyance force grant means is arranged along the crosswise ends of said conveyance side, and it considers as a pivotable conveyance roller train, supporting the crosswise ends of said sheet metal, and the top face of the top-face plate in said floatation chamber may be set as height slightly lower than the level conveyance flat surface which touches the upper bed of said conveyance roller train.

[0022] Furthermore, in the transport device of said sheet metal, it may estrange on this and crosswise both sides, this floatation chamber and the sub floatation chamber of the couple of the same configuration may be arranged to parallel to said floatation chamber, again, it may estrange on crosswise both sides of a liquid film formation field with said static pressure gas, and a sub liquid film formation field

may be prepared.

[0023] Moreover, in the transport device of said sheet metal, said conveyance force grant means may be made to be arranged between said floatation chamber and the sub floatation chamber arranged at the crosswise both sides, respectively.

[0024] Furthermore, in the transport device of said sheet metal, the guide-idler train which comes to arrange two or more guide idlers which can be freely rotated to the circumference of the revolving shaft of the direction of a vertical is established along the ends of the cross direction of said conveyance side again, the crosswise edge of said sheet metal is contacted inside the guide-idler train of this couple, and you may make it make that cross direction position.

[0025] Since a crosswise center section is surfaced with a static pressure gas to the conveyance direction of sheet metal and he is trying to give the conveyance force on those both sides, in this invention, it is not necessary to make it spout so much and to surface a high-pressure fluid in the field of a static pressure gas, that what is necessary is just to be able to maintain so that the crosswise center section of sheet metal may only become level therefore. Therefore, airstream is not disturbed even if it uses in a clean room.

[0026] Moreover, since it is only preparing many gas blowout stomata in the top-face plate of a box-like object long in the conveyance direction, the floatation chamber for forming the liquid film by the static pressure can reduce the manufacturing cost of equipment substantially.

[0027]

[Embodiment of the Invention] The example of the gestalt of operation of this invention is explained to a detail with reference to a drawing below.

[0028] As shown in drawing 1 , the transport device 10 concerning the example of the gestalt of operation of this invention For example, the floatation chamber 16 of a box-like object long in the conveyance direction arranged in the crosswise center-section location which conveys horizontally the large-sized glass substrate 12 for PDP along the conveyance side 14, and intersects perpendicularly with the conveyance direction in the conveyance side 14, the conveyance roller trains 18A and 18B of the crosswise couple arranged in the conveyance direction in the crosswise ends location in the conveyance side 14 -- since -- it is constituted.

[0029] As said floatation chamber 16 is shown in drawing 2 , it has the top-face plate 20 which is parallel to the conveyance side 14 and is equivalent to the lid of a box-like object, and many gas blowout stomata 22 are formed in this top-face plate 20.

[0030] Moreover, a clearance 28 is formed between the upper bed edge 26 of the end-face plate 26 on the backside [ the conveyance direction ] in the floatation chamber 16 of a box-like object (it sets to drawing 3 and is left-hand side), and conveyance direction back end marginal 20A of said top-face plate 20, and the dynamic pressure floatation means is constituted by flowing a dynamic pressure gas out of here like the after-mentioned so that it may expand to drawing 3 and may be shown.

[0031] To said box-like floatation chamber 16, as shown in drawing 2 , comparatively low-pressure air is supplied with a duct hose 36 through a filter 34 from a blower 32, and it is supplied from the gas blowout hole 22 and clearance 28 between said large number.

[0032] The path of said gas blowout stoma 22 is made small as compared with a clearance 28, and it is made for the air spouted from here to have the air film which is a static pressure field formed here between the rear face of a glass substrate 12, and the top face 21 of the top-face plate 20. Moreover, since the air of a large quantity is spouted from said clearance 28 as compared with the gas blowout stoma 22, the airstream which is a dynamic pressure gas will be formed in this part.

[0033] The upper bed edge 26 is made lower than underside 21A of said top-face plate 20 so that said end-face plate 24 may be expanded to drawing 3 and may be shown. Said clearance 28 It is formed in slanting facing up between underside 21A of the top-face plate 20, and the upper bed edge 26 of the end-face plate 24. By this When the airstream from a clearance 28 becomes slanting facing up and the crosswise center-section front end of a glass substrate 12 reaches here, he has spurted out from the slanting lower part and is trying for the rear face of a glass substrate 12 to become higher than the top face 21 of the top-face plate 20.

[0034] In addition, the top face 21 in said floatation chamber 16 is set up lower than the level surface which abbreviation's is in the thickness of the liquid film formed in this upside by carrying out, and passes along the upper bed of said conveyance roller trains 18A and 18B by height.

[0035] Therefore, the glass substrate 12 conveyed along the conveyance side 14 will be horizontally supported in three points of the cross direction of the conveyance side 14, when liquid film with a static pressure gas is formed between the rear face and top face 21 of the top-face plate 20.

[0036] The clearance 30 is formed [ in / according to the need / along the conveyance side 14 / in the above floatation chambers 16 / 1 or the floatation chamber 16 which is in the conveyance direction forefront location although arranged in line by more than one ] between the upper bed edge 27 of the end-face plate 25 of the conveyance direction front end, and before [ the top-face plate 20 ] side edge marginal 20B.

[0037] This clearance 30 is constituted like the above-mentioned clearance 28, spouts the airstream as a dynamic pressure gas from here, has sent out the crosswise center section of the conveyance direction back end of a glass substrate 12 from the lower part, and he is trying to become higher than a top face 21.

[0038] Although a glass substrate 12 is carried in from the upper part with a fork-like carrier robot or being carried in by conveyor etc. from the conveyance direction upstream, the transport device 10 concerning the example of the gestalt of this operation gushes the airstream as a dynamic pressure gas from said clearance 28 while gushing airstream by the predetermined pressure from the gas blowout stoma 22 in that top face 21 in the floatation chamber 16 at this time.

[0039] If it does in this way, it prevents that the head center section of the glass substrate 12 carried in hangs down, and this bottom \*\*\*\*\* center section of a lappet will collide with a transport device 10, and will not be damaged.

[0040] Moreover, conveyance of a glass substrate 12 is in the condition of having surfaced the crosswise center section of the glass substrate 12 by the floatation chamber 16. Since the crosswise ends of this glass substrate 12 are supported in the conveyance roller trains 18A and 18B and the conveyance force is given, the air supplied from the gas blowout stoma 22 in the floatation chamber 16 Liquid film is only formed, it is only trying not to contact the floatation chamber 16, and a glass substrate 12 does not need to generate the conveyance force.

[0041] Therefore, there may be few the amounts and pressures of air which are spouted from the gas blowout stoma 22 as compared with a transport device with the conventional gas, and may be low voltage. Moreover, since most part of the load of a glass substrate 12 supports the conveyance roller trains 18A and 18B by said floatation chamber 16, they can convey a glass substrate 12 along the conveyance side 14 according to few conveyance force. Furthermore, since there are few loads concerning the conveyance roller trains 18A and 18B, there is little force concerning the crosswise ends of the glass substrate 12 as the reaction force, and there is little what makes this glass substrate 12 produce distortion.

[0042] When the glass substrate 12 is horizontally conveyed along the conveyance side 14 by the floatation chamber 16 and the conveyance roller trains 18A and 18B and is passed to other transport devices from the conveyance side 14 of a transport device 10, a crosswise center section is supported and it is made not to hang down by other these transport-devices side naturally.

[0043] However, when a glass substrate 12 slips out from the conveyance side 14, it is possible that the back end hangs down and it collides with before [ the conveyance direction ] side edge marginal 20B of the floatation chamber 16.

[0044] In this transport device 10, since it has the dynamic pressure floatation means when the clearance 30 is formed in the conveyance direction front end in the floatation chamber 16 of the conveyance direction forefront edge like the above-mentioned and the airstream as a dynamic pressure gas spouts from here, the back end of this glass substrate 12 is raised, and it collides with edge 20B and is not damaged.

[0045] Although the above-mentioned transport device 10 is constituted by the conveyance roller trains 18A and 18B of the couple of one floatation chamber 16 and crosswise ends in the crosswise mid gear of the conveyance side 14, this invention is not limited to this and it may prepare a separate floatation chamber in other locations that a floatation chamber should just be what surfaces the crosswise center section in the conveyance side 14 at least. Furthermore, the conveyance roller train as a conveyance force grant means is good also as other conveyance means, such as a conveyor, and may change the crosswise location if needed.

[0046] For example, the sub floatation chambers 42A and 42B may be arranged to the floatation

chamber 16 and parallel in the location estranged on crosswise both sides of the same floatation chamber 16 of a crosswise mid gear as the above like the transport device 40 concerning the 2nd example of the gestalt of operation of this invention shown in drawing 4 , and the conveyance conveyors 44A and 44B of two trains may be arranged among these. These conveyance conveyors 44A and 44B give the conveyance force by pushing the back end of a glass substrate 12.

[0047] Furthermore, if needed, as shown in drawing 4 , the guide-idler trains 46A and 46B for \*\*\*\*(ing) to the crosswise ends side of a glass substrate 12, and carrying out the crosswise positioning may be formed in the crosswise ends location of the conveyance side 14.

[0048] Since a glass substrate 12 surfaces by the floatation chamber of three trains in the case of this transport device 40, the conveyance force given to a glass substrate 12 from the conveyance conveyors 44A and 44B becomes still smaller than the case of the conveyance roller trains 18A and 18B in a transport device 10.

[0049] Therefore, the contact pressure of the conveyance conveyors 44A and 44B and a glass substrate 12 is dramatically small, and does not soil this glass substrate 12.

[0050] Moreover, since the guide-idler trains 46A and 46B contact only the crosswise both-sides end face of a glass substrate 12, they cannot give stress unnecessary for a glass substrate 12, can guide it by slight contact pressure, and can perform crosswise positioning of a glass substrate 12 to a precision.

[0051] Drawing 5 is the sectional view showing the modification of the dynamic pressure floatation means which consists of a clearance formed between said floatation chamber 16, or the top-face plate and end-face plate in 17.

[0052] This modification estranges and arranges further the end-face plate 49 on the backside [ the conveyance direction ] in the floatation chamber 48 (it sets to drawing and is left-hand side) in the conveyance direction rather than after [ the conveyance direction ] side edge marginal 50A of the top-face plate 50, and forms a clearance 52.

[0053] The upper bed edge 53 of the end-face plate 49 is formed so that it may become the thickness direction mid-position of said top-face plate 50, and the corner on the backside [ the conveyance direction ] in this upper bed edge 53 is beveled, and let it be an inclined plane 54.

[0054] The airstream as a dynamic pressure gas spouted from a clearance 52 is mostly turned right above by this, and can surface effectively the crosswise center section of the front end of the conveyed glass substrate 12 by it.

[0055] Moreover, even if the front end of a glass substrate 12 droops a little at this time, since the inclined plane 54 is formed, it collides with the corner of the floatation chamber 48, and is not damaged.

[0056] In the example of the gestalt of each above operation, a floatation chamber is a simple core box and can be easily manufactured by low cost that what is necessary is to form a gas blowout stoma in a top-face plate, and just to prepare a clearance between a top-face plate and an end-face plate therefore.

[0057] Especially the gas blowout stoma 22 has [ that what is necessary is just what forms liquid film between the glass substrates 12 and top faces 21 which are conveyed ] large degrees of freedom of a design, such as the direction of the hole, and magnitude.

[0058] Moreover, the manufacturing cost of the equipment which includes a blower 32 since it was only sufficient to supply a low-pressure gas from a blower 32 as compared with the conventional floatation conveyance means with a dynamic pressure gas can be reduced substantially, and since complicated control of an air nozzle is still more unnecessary, structure is easy.

[0059] In addition, although the example of the gestalt of the above-mentioned operation is for conveying a glass substrate 12, this invention is not limited to this and applied about the case where the so-called thin sheet metal of board thickness is conveyed as compared with area. Therefore, in conveyance of the ingredient which is easy to produce bending of a metallic thin plate, the sheet metal of resin, etc., it is applied.

[0060] Moreover, the gas for floatation may not be limited to air and may be nitrogen gas, rare gas, etc.

[0061]

[Example] The concrete example of this invention is explained below.

[0062] The width of face of the floatation chamber 16 with the same configuration as the example of the gestalt of operation shown in drawing 1 and drawing 2 100mm, For height the gap of 50mm, a top face 21, and the level conveyance side 14 2mm, Set mileage between services according the distance between

conveyance roller train 14A and 14B to 800mm and the conveyance roller trains 14A and 14B to 1000mm, and the gas blowout stoma 22 formed in said top-face plate 20 further As shown in drawing 6 , the distance of the gas blowout stoma 22 of 5mm and crosswise both sides and the crosswise ends of the floatation chamber 16 was set up with 5mm, and the aperture was set up the conveyance direction and crosswise for the gas blowout stoma 22 of 30mm pitch, the conveyance direction front end, and the back end, and the distance of the conveyance direction forward back end side with 2mm, respectively. [0063] By this transport device, a glass substrate with the weight of 1060g, width of face of 800mm, a die length [ of 1000mm ], and a thickness of 0.7mm is carried, and the result of having measured the flying height of the glass substrate in two or more places of a top face 21 is shown in a table 1.

[0064]

[A table 1]

ブロー電源周波数	浮上量 $\delta$ 値 (mm)	
	中央測定位置	端面測定位置
60Hz	0.65	0.33
50Hz	0.55	0.3
40Hz	0.5	0.3
30Hz	0.25	0.25
20Hz	0.2	0.15

[0065] In addition, as a blower 32, the HEPA filter made from a Japanese air tech and 3A-202005T (0.5mm<sup>3</sup>/min) were used as the Fuji Electric ring blower, VFC208AN (0.84mm<sup>3</sup>/min), and a filter 34.

[0066] Furthermore, the relation of the difference of the water column height obtained in the state of measurement as indicated to be the glass substrate flying height with the dynamic pressure gas in the conveyance direction front end location and a bulb opening in the HEPA filter at this time to drawing 7 came to be shown in a table 2.

[0067]

[A table 2]

バルブ開度%	水柱高さの差Δ mm	ガラスの浮上量 mm
1へパフィルター前		
100%	161	
50%	39	
25%	6	
10%	5	
2へパフィルター後		
100%	86	0.75
50%	37	0.55
25%	6	0.3
10%	2	0.2

[0068] Thereby, with the top-face plate up side, it turns out that the uniform flying height is obtained comparatively with low voltage, and the flying height corresponding to the air pressure force is obtained in the conveyance direction front end location. Moreover, the glass substrate contacted the floatation chamber by neither of the cases.

[0069]

[Effect of the Invention] Since this invention was constituted as mentioned above, it is low cost, and turbulence of the air in a clean room etc. is not produced, and it has the outstanding effectiveness that it is stabilized horizontally and sheet metal, such as a large-sized glass substrate, can be conveyed.

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**TECHNICAL FIELD**

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[Field of the Invention] This invention relates to the approach and equipment which convey sheet metal like the large-sized and thin glass substrate used for plate displays, such as a liquid crystal display (LCD) panel and a plasma display panel (PDP).

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**PRIOR ART**

[Description of the Prior Art] 800mmx1000mm and thickness are 0.7 etc.mm etc., and the large-sized glass substrate for LCD panels has dramatically thin size compared with magnitude.

[0003] Therefore, although it will hang down greatly if not only the crosswise ends but a crosswise center section is not supported in case a glass substrate is conveyed horizontally, it is required that a transport device etc. should not contact the part excluding [ such a glass substrate especially ] the periphery edge.

[0004] The technique which a substrate is surfaced as a means for this using gases, such as air which is indicated by JP,10-139160,A, JP,11-268830,A, JP,11-268831,A, etc., for example, and is conveyed by non-contact is proposed.

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[Translation done.]

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**EFFECT OF THE INVENTION**

[Effect of the Invention] Since this invention was constituted as mentioned above, it is low cost, and turbulence of the air in a clean room etc. is not produced, and it has the outstanding effectiveness that it is stabilized horizontally and sheet metal, such as a large-sized glass substrate, can be conveyed.

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**TECHNICAL PROBLEM**

[Problem(s) to be Solved by the Invention] However, by making it the above transport devices spout the compressed air etc. from two or more nozzles, and controlling the blowout direction, a blowout, and a halt intricately Since a substrate is surfaced and he is trying to make it convey in the direction of the object, while a manufacturing cost and operation cost become very high, it sets, for example in a clean room. Since the air of a comparatively high pressure etc. spouts from two or more nozzles, there is a trouble of producing turbulence of the air in a clean room.

[0006] Furthermore, in order to solve such a trouble, a porosity ceramics plate is arranged horizontally, air is sent in from the bottom, liquid film is formed between the glass substrate conveyed and porosity ceramics, and there is a thing it was made to surface a glass substrate by this.

[0007] However, since it cannot respond to the center section of the glass substrate hanging down in case it passes a thin large-sized glass substrate to other conveyance means from the transport device which consists of a porosity ceramics plate or it is received conversely, while this porosity ceramics plate is dramatically expensive and a manufacturing cost will increase, there is a trouble that fork-like lift equipment must be used.

[0008] This invention is made in view of the above-mentioned conventional trouble, and aims at offering the conveyance approach of sheet metal and equipment which were low cost, and enabled it to convey sheet metal, such as a large-sized glass substrate, horizontally, without producing turbulence of the air in a clean room etc.

[0009] Moreover, it aims at offering the conveyance approach of sheet metal and equipment it enabled it to deliver and convey, without using a lift at the time of delivery between transport devices, as the center section of sheet metal hanging down does not arise.

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**MEANS**

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[Means for Solving the Problem] This approach invention is two places of a before [ from the crosswise both sides of said center section / ends ], and attains the above-mentioned object by the conveyance approach of the sheet metal characterized by giving the conveyance force while it surfaces a center section at least with the liquid film of the cross direction which intersects perpendicularly to the conveyance direction of sheet metal which consists of a static pressure gas.

[0011] The conveyance direction head of said sheet metal center section is surfaced with a dynamic pressure gas, and you may make it deliver to a degree in the conveyance approach of said sheet metal in the location where said liquid film breaks off.

[0012] Moreover, when sheet metal is sent into the static pressure field which surfaces the center section of sheet metal with said liquid film, the conveyance direction head of said sheet metal center section sent in is surfaced in the conveyance direction back end location of said static pressure field, and you may make it deliver sheet metal to it to said static pressure field in the conveyance approach of said sheet metal.

[0013] Furthermore, you may make it stop conveyance of said sheet metal by reducing the pressure of said static pressure gas in the conveyance approach of said sheet metal again.

[0014] Moreover, the sail which can be freely detached and attached at a part of periphery edge of said sheet metal is attached, and you may make it send a wind in the conveyance approach of said sheet metal, so that the thrust of the conveyance direction of sheet metal may be produced to this sail.

[0015] It is a box-like object long in the conveyance direction arranged in the location of the cross direction which intersects perpendicularly with the conveyance direction in a level conveyance side which is equivalent to a center section at least. this equipment invention -- the abbreviation for sheet metal -- Many gas blowout holes are formed in a top-face plate parallel to said conveyance side, and a gas is supplied from this gas blowout hole. Between said top-face plates and sheet metal undersides The floatation chamber which forms the liquid film which consists of a static pressure gas which surfaces said center section, While being arranged in said conveyance direction and supporting said sheet metal in the part between the crosswise center section in said conveyance side and the crosswise ends of the crosswise both sides of this floatation chamber, the transport device of sheet metal which comes to have a conveyance force grant means to give the conveyance force attains the above-mentioned object.

[0016] In the transport device of said sheet metal, a dynamic pressure floatation means to spout the dynamic pressure gas which surfaces the conveyance direction head of said sheet metal may be formed in facing up or slanting facing up in the edge location of the conveyance direction in said floatation chamber.

[0017] Furthermore, in the transport device of said sheet metal, said dynamic pressure floatation means may be made to be constituted so that an application-of-pressure gas may be gushed from the clearance between locations lower than the top face of said top-face plate between the upper bed edge of the conveyance direction end-face plate of the box-like object which constitutes said floatation chamber, and the conveyance direction edge of said top-face plate.

[0018] Furthermore, again, in the transport device of said sheet metal, said clearance is formed between the medial surface of said end-face plate, and said conveyance direction edge of said top-face plate, and may be made to be arranged lower than the top face of said top-face plate by the upper bed edge of

said end-face plate in a location higher than an underside.

[0019] Moreover, in the transport device of said sheet metal, it is good also as an inclined plane where the corner of said clearance in the upper bed of said end-face plate and an opposite hand was beveled.

[0020] Furthermore, in the transport device of said sheet metal, it is arranged at the gas path between the blower which sends a gas into at least one place of said floatation chamber, and this blower and said floatation chamber again, and you may make it prepare the filter which makes regularity the speed of supply of the gas from said blower.

[0021] Moreover, in the transport device of said sheet metal, said conveyance force grant means is arranged along the crosswise ends of said conveyance side, and it considers as a pivotable conveyance roller train, supporting the crosswise ends of said sheet metal, and the top face of the top-face plate in said floatation chamber may be set as height slightly lower than the level conveyance flat surface which touches the upper bed of said conveyance roller train.

[0022] Furthermore, in the transport device of said sheet metal, it may estrange on this and crosswise both sides, this floatation chamber and the sub floatation chamber of the couple of the same configuration may be arranged to parallel to said floatation chamber, again, it may estrange on crosswise both sides of a liquid film formation field with said static pressure gas, and a sub liquid film formation field may be prepared.

[0023] Moreover, in the transport device of said sheet metal, said conveyance force grant means may be made to be arranged between said floatation chamber and the sub floatation chamber arranged at the crosswise both sides, respectively.

[0024] Furthermore, in the transport device of said sheet metal, the guide-idler train which comes to arrange two or more guide idlers which can be freely rotated to the circumference of the revolving shaft of the direction of a vertical is established along the ends of the cross direction of said conveyance side again, the crosswise edge of said sheet metal is contacted inside the guide-idler train of this couple, and you may make it make that cross direction position.

[0025] Since a crosswise center section is surfaced with a static pressure gas to the conveyance direction of sheet metal and he is trying to give the conveyance force on those both sides, in this invention, it is not necessary to make it spout so much and to surface a high-pressure fluid in the field of a static pressure gas, that what is necessary is just to be able to maintain so that the crosswise center section of sheet metal may only become level therefore. Therefore, airstream is not disturbed even if it uses in a clean room.

[0026] Moreover, since it is only preparing many gas blowout stomata in the top-face plate of a box-like object long in the conveyance direction, the floatation chamber for forming the liquid film by the static pressure can reduce the manufacturing cost of equipment substantially.

[0027]

[Embodiment of the Invention] The example of the gestalt of operation of this invention is explained to a detail with reference to a drawing below.

[0028] As shown in drawing 1 , the transport device 10 concerning the example of the gestalt of operation of this invention For example, the floatation chamber 16 of a box-like object long in the conveyance direction arranged in the crosswise center-section location which conveys horizontally the large-sized glass substrate 12 for PDP along the conveyance side 14, and intersects perpendicularly with the conveyance direction in the conveyance side 14, the conveyance roller trains 18A and 18B of the crosswise couple arranged in the conveyance direction in the crosswise ends location in the conveyance side 14 -- since -- it is constituted.

[0029] As said floatation chamber 16 is shown in drawing 2 , it has the top-face plate 20 which is parallel to the conveyance side 14 and is equivalent to the lid of a box-like object, and many gas blowout stomata 22 are formed in this top-face plate 20.

[0030] Moreover, a clearance 28 is formed between the upper bed edge 26 of the end-face plate 26 on the backside [ the conveyance direction ] in the floatation chamber 16 of a box-like object (it sets to drawing 3 and is left-hand side), and conveyance direction back end marginal 20A of said top-face plate 20, and the dynamic pressure floatation means is constituted by flowing a dynamic pressure gas out of here like the after-mentioned so that it may expand to drawing 3 and may be shown.

[0031] To said box-like floatation chamber 16, as shown in drawing 2 , comparatively low-pressure air is supplied with a duct hose 36 through a filter 34 from a blower 32, and it is supplied from the gas blowout

nozzle 22 and clearance 28 between said large number.

[0032] The path of said gas blowout stoma 22 is made small as compared with a clearance 28, and it is made for the air spouted from here to have the air film which is a static pressure field formed here between the rear face of a glass substrate 12, and the top face 21 of the top-face plate 20. Moreover, since the air of a large quantity is spouted from said clearance 28 as compared with the gas blowout stoma 22, the airstream which is a dynamic pressure gas will be formed in this part.

[0033] The upper bed edge 26 is made lower than underside 21A of said top-face plate 20 so that said end-face plate 24 may be expanded to drawing 3 and may be shown. Said clearance 28 It is formed in slanting facing up between underside 21A of the top-face plate 20, and the upper bed edge 26 of the end-face plate 24. By this When the airstream from a clearance 28 becomes slanting facing up and the crosswise center-section front end of a glass substrate 12 reaches here, he has spurted out from the slanting lower part and is trying for the rear face of a glass substrate 12 to become higher than the top face 21 of the top-face plate 20.

[0034] In addition, the top face 21 in said floatation chamber 16 is set up lower than the level surface which abbreviation's is in the thickness of the liquid film formed in this upside by carrying out, and passes along the upper bed of said conveyance roller trains 18A and 18B by height.

[0035] Therefore, the glass substrate 12 conveyed along the conveyance side 14 will be horizontally supported in three points of the cross direction of the conveyance side 14, when liquid film with a static pressure gas is formed between the rear face and top face 21 of the top-face plate 20.

[0036] The clearance 30 is formed [ in / according to the need / along the conveyance side 14 / in the above floatation chambers 16 / 1 or the floatation chamber 16 which is in the conveyance direction forefront location although arranged in line by more than one ] between the upper bed edge 27 of the end-face plate 25 of the conveyance direction front end, and before [ the top-face plate 20 ] side edge marginal 20B.

[0037] This clearance 30 is constituted like the above-mentioned clearance 28, spouts the airstream as a dynamic pressure gas from here, has sent out the crosswise center section of the conveyance direction back end of a glass substrate 12 from the lower part, and he is trying to become higher than a top face 21.

[0038] Although a glass substrate 12 is carried in from the upper part with a fork-like carrier robot or being carried in by conveyor etc. from the conveyance direction upstream, the transport device 10 concerning the example of the gestalt of this operation gushes the airstream as a dynamic pressure gas from said clearance 28 while gushing airstream by the predetermined pressure from the gas blowout stoma 22 in that top face 21 in the floatation chamber 16 at this time.

[0039] If it does in this way, it prevents that the head center section of the glass substrate 12 carried in hangs down, and this bottom \*\*\*\*\* center section of a lappet will collide with a transport device 10, and will not be damaged.

[0040] Moreover, conveyance of a glass substrate 12 is in the condition of having surfaced the crosswise center section of the glass substrate 12 by the floatation chamber 16. Since the crosswise ends of this glass substrate 12 are supported in the conveyance roller trains 18A and 18B and the conveyance force is given, the air supplied from the gas blowout stoma 22 in the floatation chamber 16 Liquid film is only formed, it is only trying not to contact the floatation chamber 16, and a glass substrate 12 does not need to generate the conveyance force.

[0041] Therefore, there may be few the amounts and pressures of air which are spouted from the gas blowout stoma 22 as compared with a transport device with the conventional gas, and may be low voltage. Moreover, since most part of the load of a glass substrate 12 supports the conveyance roller trains 18A and 18B by said floatation chamber 16, they can convey a glass substrate 12 along the conveyance side 14 according to few conveyance force. Furthermore, since there are few loads concerning the conveyance roller trains 18A and 18B, there is little force concerning the crosswise ends of the glass substrate 12 as the reaction force, and there is little what makes this glass substrate 12 produce distortion.

[0042] When the glass substrate 12 is horizontally conveyed along the conveyance side 14 by the floatation chamber 16 and the conveyance roller trains 18A and 18B and is passed to other transport devices from the conveyance side 14 of a transport device 10, a crosswise center section is supported and it is made not to hang down by other these transport-devices side naturally.

[0043] However, when a glass substrate 12 slips out from the conveyance side 14, it is possible that the back end hangs down and it collides with before [ the conveyance direction ] side edge marginal 20B of the floatation chamber 16.

[0044] In this transport device 10, since it has the dynamic pressure floatation means when the clearance 30 is formed in the conveyance direction front end in the floatation chamber 16 of the conveyance direction forefront edge like the above-mentioned and the airstream as a dynamic pressure gas spouts from here, the back end of this glass substrate 12 is raised, and it collides with edge 20B and is not damaged.

[0045] Although the above-mentioned transport device 10 is constituted by the conveyance roller trains 18A and 18B of the couple of one floatation chamber 16 and crosswise ends in the crosswise mid gear of the conveyance side 14, this invention is not limited to this and it may prepare a separate floatation chamber in other locations that a floatation chamber should just be what surfaces the crosswise center section in the conveyance side 14 at least. Furthermore, the conveyance roller train as a conveyance force grant means is good also as other conveyance means, such as a conveyor, and may change the crosswise location if needed.

[0046] For example, the sub floatation chambers 42A and 42B may be arranged to the floatation chamber 16 and parallel in the location estranged on crosswise both sides of the same floatation chamber 16 of a crosswise mid gear as the above like the transport device 40 concerning the 2nd example of the gestalt of operation of this invention shown in drawing 4 , and the conveyance conveyors 44A and 44B of two trains may be arranged among these. These conveyance conveyors 44A and 44B give the conveyance force by pushing the back end of a glass substrate 12.

[0047] Furthermore, if needed, as shown in drawing 4 , the guide-idler trains 46A and 46B for \*\*\*\*(ing) to the crosswise ends side of a glass substrate 12, and carrying out the crosswise positioning may be formed in the crosswise ends location of the conveyance side 14.

[0048] Since a glass substrate 12 surfaces by the floatation chamber of three trains in the case of this transport device 40, the conveyance force given to a glass substrate 12 from the conveyance conveyors 44A and 44B becomes still smaller than the case of the conveyance roller trains 18A and 18B in a transport device 10.

[0049] Therefore, the contact pressure of the conveyance conveyors 44A and 44B and a glass substrate 12 is dramatically small, and does not soil this glass substrate 12.

[0050] Moreover, since the guide-idler trains 46A and 46B contact only the crosswise both-sides end face of a glass substrate 12, they cannot give stress unnecessary for a glass substrate 12, can guide it by slight contact pressure, and can perform crosswise positioning of a glass substrate 12 to a precision.

[0051] Drawing 5 is the sectional view showing the modification of the dynamic pressure floatation means which consists of a clearance formed between said floatation chamber 16, or the top-face plate and end-face plate in 17.

[0052] This modification estranges and arranges further the end-face plate 49 on the backside [ the conveyance direction ] in the floatation chamber 48 (it sets to drawing and is left-hand side) in the conveyance direction rather than after [ the conveyance direction ] side edge marginal 50A of the top-face plate 50, and forms a clearance 52.

[0053] The upper bed edge 53 of the end-face plate 49 is formed so that it may become the thickness direction mid-position of said top-face plate 50, and the corner on the backside [ the conveyance direction ] in this upper bed edge 53 is beveled, and let it be an inclined plane 54.

[0054] The airstream as a dynamic pressure gas spouted from a clearance 52 is mostly turned right above by this, and can surface effectively the crosswise center section of the front end of the conveyed glass substrate 12 by it.

[0055] Moreover, even if the front end of a glass substrate 12 droops a little at this time, since the inclined plane 54 is formed, it collides with the corner of the floatation chamber 48, and is not damaged.

[0056] In the example of the gestalt of each above operation, a floatation chamber is a simple core box and can be easily manufactured by low cost that what is necessary is to form a gas blowout stoma in a top-face plate, and just to prepare a clearance between a top-face plate and an end-face plate therefore.

[0057] Especially the gas blowout stoma 22 has [ that what is necessary is just what forms liquid film between the glass substrates 12 and top faces 21 which are conveyed ] large degrees of freedom of a

design, such as the direction of the hole, and magnitude.

[0058] Moreover, the manufacturing cost of the equipment which includes a blower 32 since it was only sufficient to supply a low-pressure gas from a blower 32 as compared with the conventional floatation conveyance means with a dynamic pressure gas can be reduced substantially, and since complicated control of an air nozzle is still more unnecessary, structure is easy.

[0059] In addition, although the example of the gestalt of the above-mentioned operation is for conveying a glass substrate 12, this invention is not limited to this and applied about the case where the so-called thin sheet metal of board thickness is conveyed as compared with area. Therefore, in conveyance of the ingredient which is easy to produce bending of a metallic thin plate, the sheet metal of resin, etc., it is applied.

[0060] Moreover, the gas for floatation may not be limited to air and may be nitrogen gas, rare gas, etc.

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[Translation done.]

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**EXAMPLE**

[Example] The concrete example of this invention is explained below.

[0062] The width of face of the floatation chamber 16 with the same configuration as the example of the gestalt of operation shown in drawing 1 and drawing 2 100mm, For height the gap of 50mm, a top face 21, and the level conveyance side 14 2mm, Set mileage between services according the distance between conveyance roller train 14A and 14B to 800mm and the conveyance roller trains 14A and 14B to 1000mm, and the gas blowout stoma 22 formed in said top-face plate 20 further As shown in drawing 6 , the distance of the gas blowout stoma 22 of 5mm and crosswise both sides and the crosswise ends of the floatation chamber 16 was set up with 5mm, and the aperture was set up the conveyance direction and crosswise for the gas blowout stoma 22 of 30mm pitch, the conveyance direction front end, and the back end, and the distance of the conveyance direction forward back end side with 2mm, respectively.

[0063] By this transport device, a glass substrate with the weight of 1060g, width of face of 800mm, a die length [ of 1000mm ], and a thickness of 0.7mm is carried, and the result of having measured the flying height of the glass substrate in two or more places of a top face 21 is shown in a table 1.

[0064]

[A table 1]

ブロー電源周波数	浮上量δ値 (mm)	
	中央測定位置	端面測定位置
60Hz	0.65	0.33
50Hz	0.55	0.3
40Hz	0.5	0.3
30Hz	0.25	0.25
20Hz	0.2	0.15

[0065] In addition, as a blower 32, the HEPA filter made from a Japanese air tech and 3A-202005T (0.5mm<sup>3</sup>/min) were used as the Fuji Electric ring blower, VFC208AN (0.84mm<sup>3</sup>/min), and a filter 34.

[0066] Furthermore, the relation of the difference of the water column height obtained in the state of measurement as indicated to be the glass substrate flying height with the dynamic pressure gas in the conveyance direction front end location and a bulb opening in the HEPA filter at this time to drawing 7 came to be shown in a table 2.

[0067]

[A table 2]

バルブ開度%	水柱高さの差Δ mm	ガラスの浮上量 mm
1 へパフィルター前		
100%	161	
50%	39	
25%	6	
10%	5	
2 へパフィルター後		
100%	86	0.75
50%	37	0.55
25%	6	0.3
10%	2	0.2

[0068] Thereby, with the top-face plate up side, it turns out that the uniform flying height is obtained comparatively with low voltage, and the flying height corresponding to the air pressure force is obtained in the conveyance direction front end location. Moreover, the glass substrate contacted the floatation chamber by neither of the cases.

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**DESCRIPTION OF DRAWINGS**

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**[Brief Description of the Drawings]**

**[Drawing 1]** The front view showing the transport device concerning the example of the gestalt of operation of this invention

**[Drawing 2]** This top view

**[Drawing 3]** The sectional view showing the floatation chamber in this transport device

**[Drawing 4]** The sectional view showing the transport device concerning the 2nd example of the gestalt of operation of this invention

**[Drawing 5]** The sectional view showing the modification of the dynamic pressure floatation means in the transport device of this invention

**[Drawing 6]** The top view showing arrangement of the gas blowout stoma in the floatation chamber in the example of this invention

**[Drawing 7]** The side elevation showing the measuring device at the time of measuring the flying height of the glass in the example of this invention

**[Description of Notations]**

10 40 -- Transport device

12 -- Glass substrate

14 -- Conveyance side

16, 17, 48 -- Floatation chamber

18A, 18B -- Conveyance roller train

20 50 -- Top-face plate

20A, 20B -- Edge

21 -- Top face

21A -- Underside

22 -- Gas blowout stoma

24, 25, 49 -- End-face plate

26, 27, 53 -- Up edge

28, 30, 52 -- Clearance

32 -- Blower

34 -- Filter

42A, 42B -- Sub floatation chamber

44A, 44B -- Conveyance conveyor

46A, 46B -- Guide-idler train

54 -- Inclined plane

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**[Translation done.]**

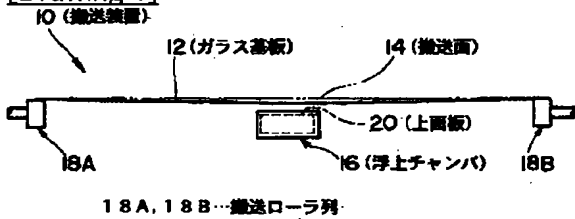
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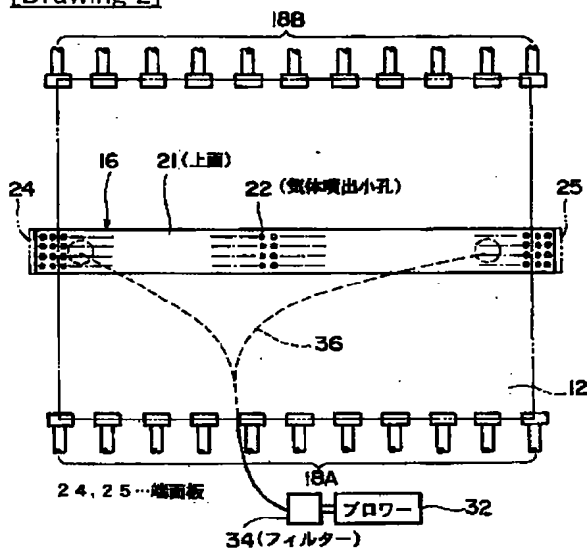
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DRAWINGS

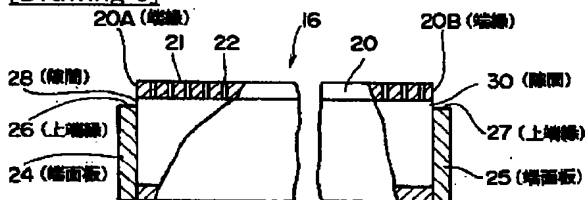
[Drawing 1]



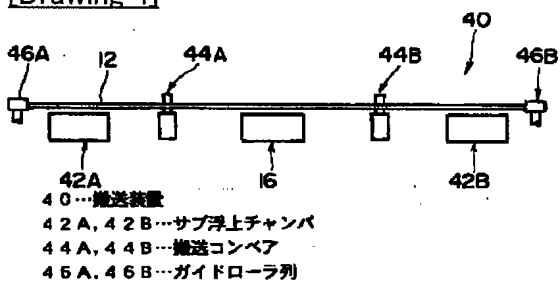
[Drawing 2]



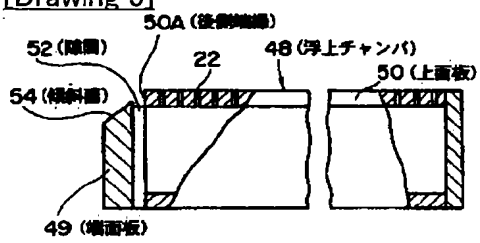
[Drawing 3]



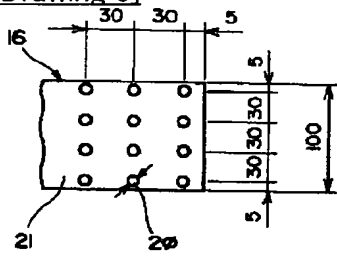
[Drawing 4]



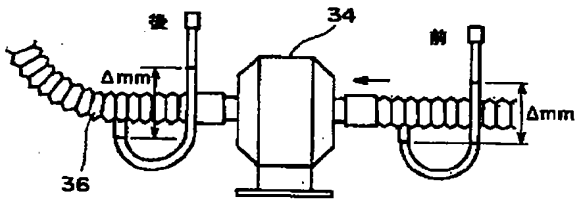
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]